



# Synergies from co-digestion of grass silage with other feedstocks

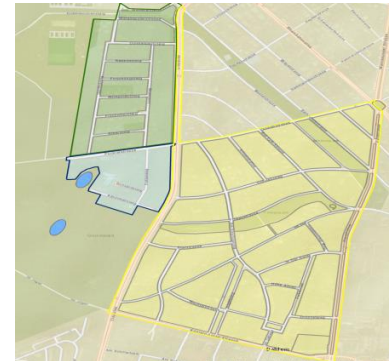
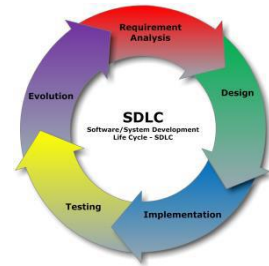
Himanshu



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# Introduction

- 2003-2007: Engineering Biotechnology
  - Uttar Pradesh Technical University, India
- 2007-2010: Software Engineer
  - Infosys, India
- 2010-2013: MSc. Water Science
  - University of Duisburg-Essen, Germany
  - Internship: Max-Planck Institute for Chemical Ecology, Jena
    - How plants perceive terrestrial gastropods?
  - Master thesis: Ingenieurgesellschaft Prof. Dr. Sieker mbH, Berlin
    - Urban storm water management
- 2014-Present: PhD
  - Teagasc, Ireland and University college cork, Ireland

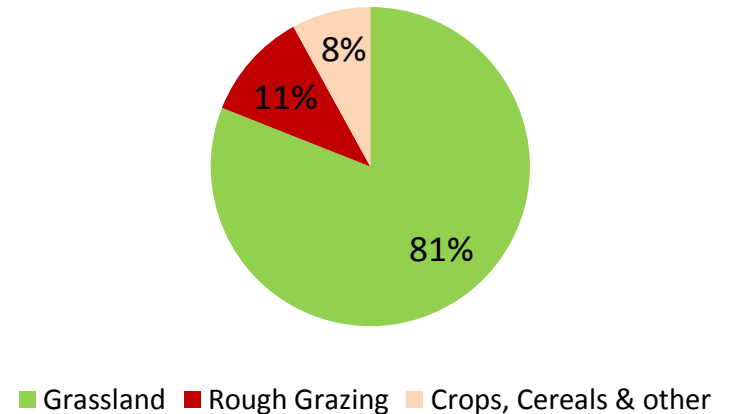


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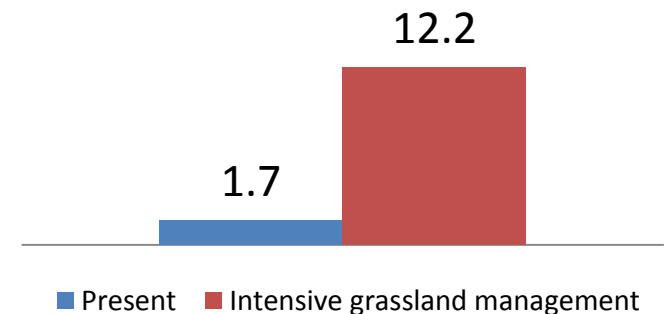
# Introduction

- Ireland has 4.2 M ha of agricultural land.
- 1.7 M t grass dry matter (DM) in excess of livestock requirements (McEniry et al., 2013).
- Intensive grassland management → Up to 12.2 M t DM/a (McEniry et al., 2013).
- 10% of Ireland's grassland area → Fuel up to 55% of all passenger cars (Wall et al., 2013).
- In 2010 there were 1.07 M dairy cows → 7.07 M t DM/annum for 20 weeks winter storage period of slurry (Wall et al., 2013).
- Long term mono-digestion of grass silage can suffer due to a deficiency in essential nutrients
  - Addition of slurry can provide these nutrients.
- Co-digestion of silage and slurry may produce synergistic effects providing higher biogas yield compared to mono-digestion of silage or slurry.

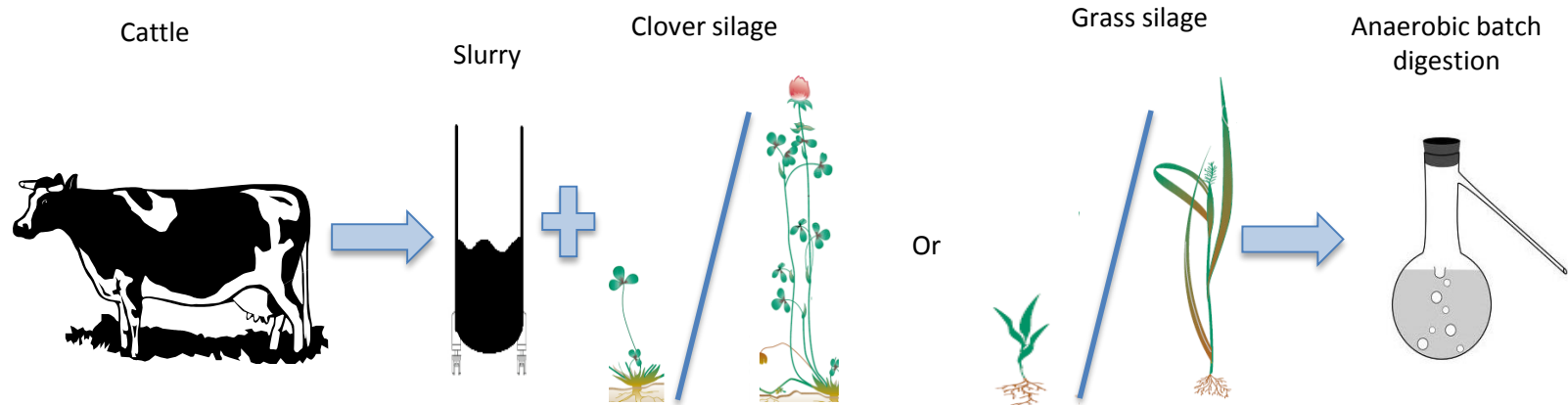
Ireland's agricultural land utilization



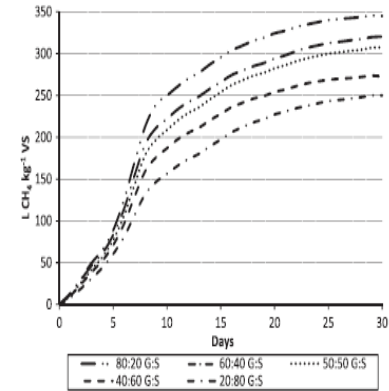
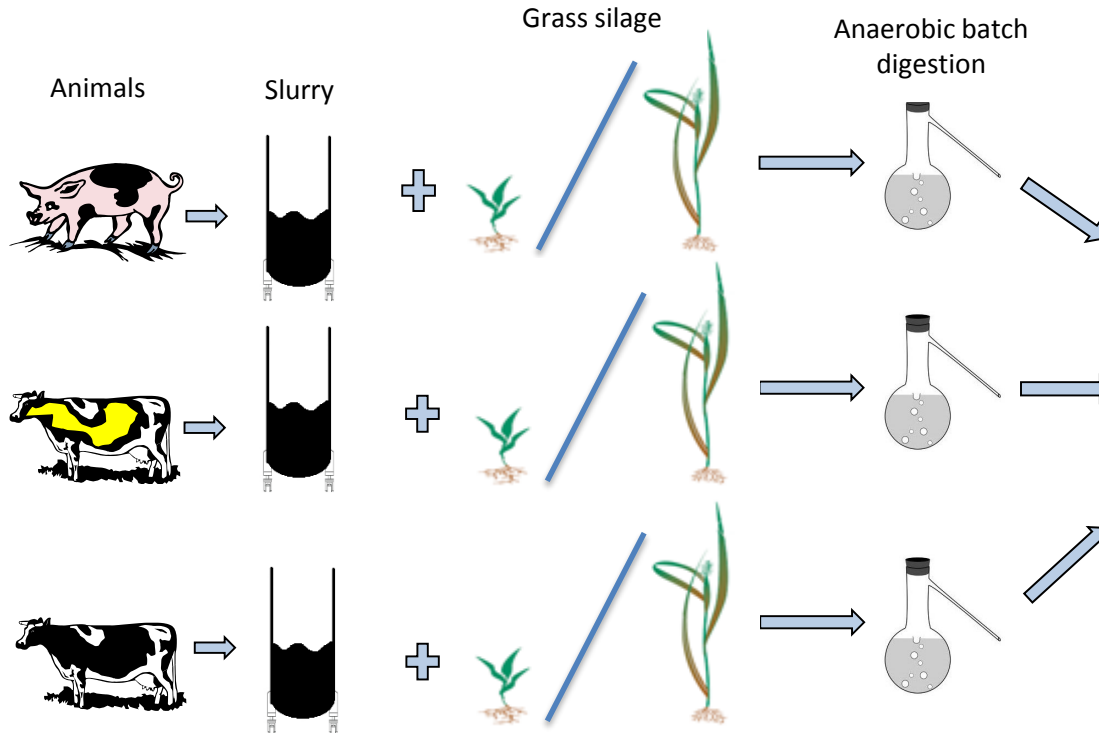
Grass silage in excess of livestock requirements



# Co-digestion of grass/red clover silages with cattle slurry



# Co-digestion of different slurry types with grass silages



Specific methane yields for co-digestion. G - grass silage, S - slurry (Wall et al, 2013)

➤ In-progress

# Co-digestion of grass/red clover silages with cattle slurry

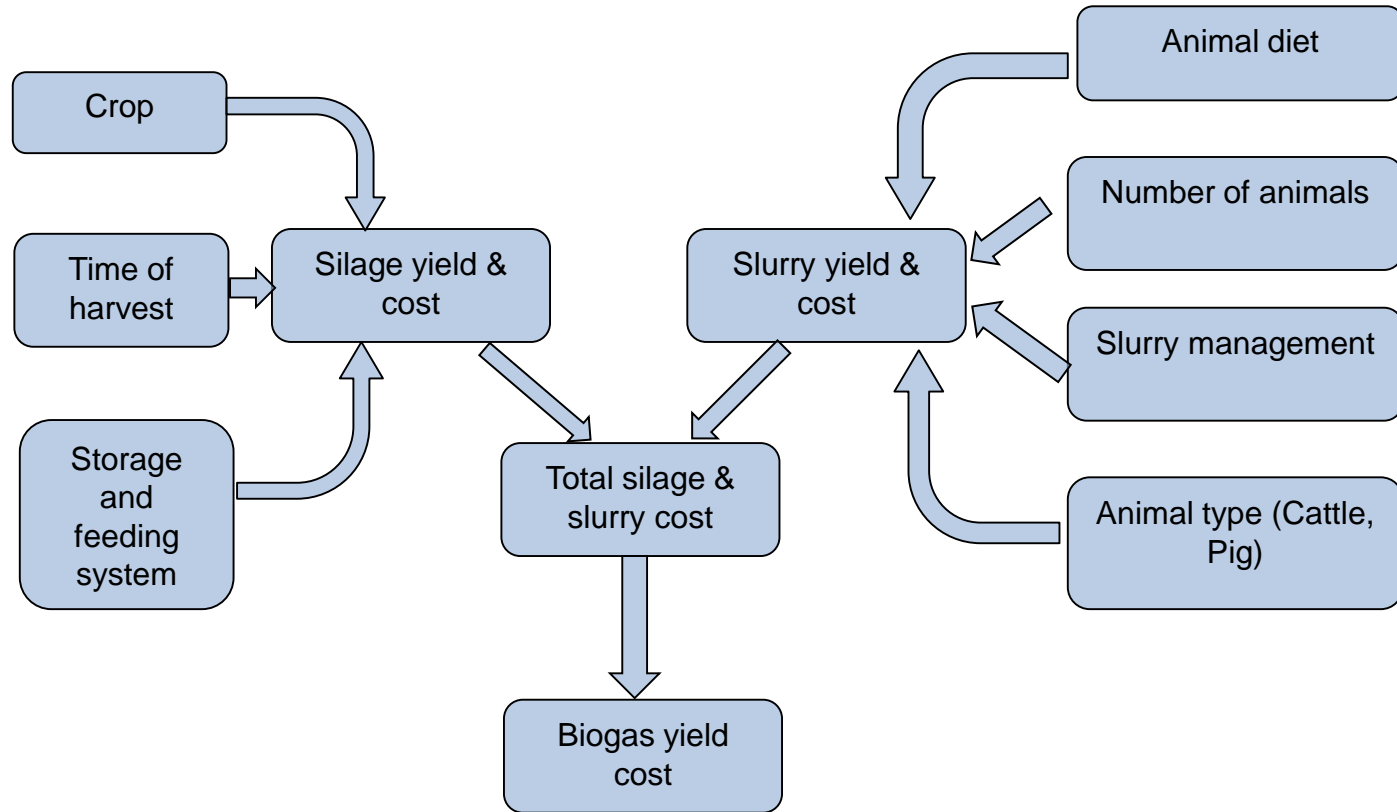
## ➤ Deliverables:

- D4a) Setting up of lab-scale digester (initial trials) , (M12)
- D4b) Assessment of optimal combinations of feedstock (Report), (M21)

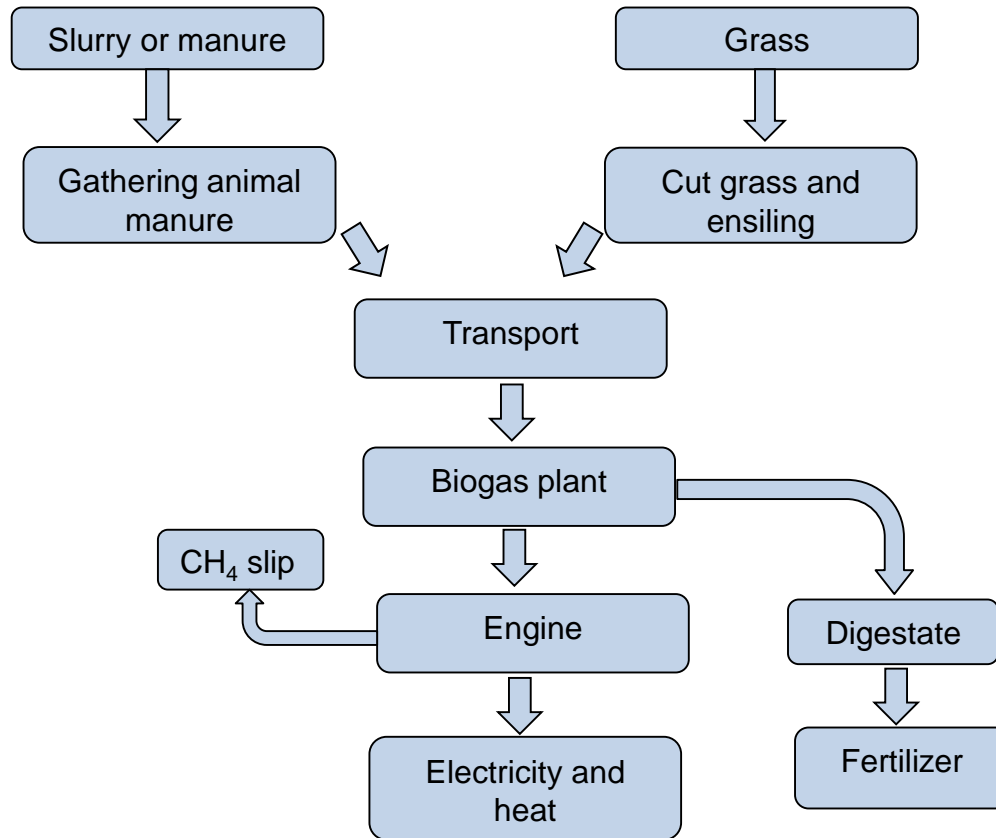
## ➤ Submitted two abstracts

- Himanshu, H.; Murphy, J.D.; O'Kiely, P. (Submitted manuscript) Biomethane production from co-digestion of forage silage and cattle slurry. In *14th World Congress on Anaerobic Digestion*. Chile
- O'Kiely, P.; Nolan, P.; Wall, D.M.; Himanshu, H.; Lenehan, J.J.; Doyle, E.M.; Murphy, J.D. (Submitted manuscript) Biogas from grass silage. In *6th Nordic Feed Science Conference*. Uppsala, Sweden

# Economic modelling of biogas yield from the co-digestion of silage and slurry



# LCA of anaerobic digester fed with grass silage and slurry mixture





# Questions?





Thanks for listening



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Project coordinated by the QUESTOR Centre  
at Queen's University Belfast  
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